in the extreme northern portion in Wisconsin and Minnesota which received no precipitation during this period.

The damage was only nominal as crops had not as yet been planted. In fact, the deposit of new soil was reported to be beneficial.

Missouri Basin.—There were no floods in the Missouri Basin in February. In March, the heavy rains of the storm of March 11–12 resulted in the Grand River going above flood stage. The flooding was not extensive or damaging. On the Missouri River unusually warm weather caused much snow to melt. Considerable flooding resulted in the headwaters, and at lower levels ice gorges formed with local floods at Bismarck, N. Dak., and Nebraska City, Nebr. The stages at these latter stations were not extreme. Of the rise in the headwaters of the river, the following description is given by the official in charge, Helena, Mont.:

Sudden melting of what remained of winter's accumulation of snow and ice on the lower levels combined with the frozen condition of the ground that prevented absorption of the snow water caused freshets and floods in northern streams and rivers during the week beginning March 18. Ice gorges were responsible for some of the flood conditions. Principal flooded areas were along the Milk and extreme lower Yellowstone Rivers, and the Big Muddy, Porcupine, and Poplar Creeks. The Milk River was reported in flood from Lohman in western Blaine County to Nashua in eastern Valley County. Numerous homes were evacuated in Malta, Chinook, Hinsdale, Saco, and in farming communities scattered throughout the flooded area.

The flood waters of the Milk River and its tributaries, and other streams, washed out bridges, railroad and highway grades, and interrupted rail and highway traffic for 2 to several days.

Considerable loss of livestock was reported, particularly sheep. There was much damage to farm and town buildings and related property. Flood waters of the Milk River were considered the greatest since 1917 in the affected area. In the Big Muddy section the spring run-off was reported the greatest in history.

Ohio Basin.—The outstanding flood of this period was that of the Ohio River drainage. The flood was not unduly severe, but its long duration, especially in the lower reaches throughout the wet weeks of February and March, and with memories of the great flood of 1937 still fresh in the minds of residents, it caused great apprehension. This was, however, of benefit, as people evacuated their homes, and property and stock were removed in ample time so that the damage was less in proportion to the stages reached than in most other Ohio floods.

As compared with the 1937 flood, the period of wet weather was longer, the total amounts of precipitation less and the rises in the tributaries more favorably timed. As a result, stages were not disastrously high except in the headwaters of a few of the southern tributaries of the Ohio River where new records were established.

The Ohio flood had its inception in the last 3 days of January when a general storm gave rains of about 2 inches over the entire basin, followed by another storm on February 2–3 which was centered over the upper Ohio River and the Kentucky and Cumberland headwaters. Rainfall depths varied from 2 inches over the Pittsburgh area to 4 and 5 inches over the upper Cumberland watershed. On February 3 warnings were issued for all stations on the Ohio River and most of its southern tributaries.

Rains were quite well distributed from the beginning of February until the middle of March, but there were two well-defined storm periods which resulted in two crests on much of the Ohio River. The first storm was the one of February 3–4, and the second occurred on March 4 and 5.

With the exception of the White and Wabash Rivers, serious flooding did not occur in the tributaries to the north of the Ohio River. Part of the precipitation over these northern tributaries during February was in the form of snow which served to delay the period of run-off with resulting lower crests.

The rainfall amounts at a number of stations for this flood and for the great flood of January–February 1937 are listed below:

	Dec. 26–Jan. 25 1937	Jan. 30–Mar. 15, 1939
Pittsburgh, Pa.	7.03	7.06
Parkersburg, W. Va.	9.56	10.03
Cincinnati, Ohio	15.21	10.30
Evansville, Ind.	15.42	12.64
Nashville, Tenn.	15.53	12.22
Indianapolis, Ind.	10.28	8.14

In western Pennsylvania and West Virginia there was a considerable snow cover in the mountains which contributed to the run-off from the first February storm. Considering this added increment of snow run-off, the precipitation in the headwaters of the Ohio Basin was greater than in 1937, and higher stages resulted than in 1937 on the Tygart, Youghiogheny, Monongahela, Walhonding, Little Kanawha, Elk, Guyandot, Twelve Pole Creek, Big Sandy and its tributaries, Little Sandy, and the Kentucky River down to lock No. 10. On the Cumberland River, Williamsburg, Ky., and Burnside, Ky., exceeded their 1937 crests, as did stages on the Hiwassee River at Charleston, Tenn., and on the Tennessee River at Florence, Ala., and Savannah, Tenn.

From this it can be seen that the major source of the Ohio flood was in the southern and eastern headwaters. Of the tributaries to the north, only the Scioto River at La Rue, Ohio, had a stage greater than in 1937. However, the flood stages on this river occurred in the middle of March and reached the Ohio River when its height was well below flood stage.

In addition to the general storms which covered the entire basin with generous precipitation, there were others which embraced only a portion of the area. This was especially true in the southern part of the Ohio River Basin where a number of disturbances gave heavy precipitation over the Cumberland and Tennessee River drainages. On the night of March 11–12 heavy rains up to 3 inches depth fell over the White, Wabash, and Scioto River Basins. The maximum crests of the different rises occurred after this storm.

In the lower reaches of the Ohio River, the flood was distinguished by its long duration above flood stage. A comparison at a few selected stations of the number of days above flood stage in this flood and in the 1937 flood are given:

	1939	1937
Pittsburgh, Pa.	1	10
Cincinnati, Ohio	5	19
Louisville, Ky.	7	23
Dam No. 44, Leavenworth, Ind.	15	25
Evansville, Ind.	48	41
Paducah, Ky.	47	44
Cairo, Ill.	50	50

DISTRICT REPORTS

OHIO RIVER AND TRIBUTARIES AT AND ABOVE DAM NO. 13

By W. S. BROTZMAN

Rain set in over practically the entire Pittsburgh district during the early morning of February 2, and continued until the afternoon of the 3d. The amounts of rainfall reported on the morning of the 2d were light, but by the morning of the 3d there was an average

of 1.30 inches over the upper Monongahela Basin, and an average of about 0.75 inch over the Allegheny Basin as far north as Red Bank Creek. By the afternoon of the 3d there was an additional 0.70 inch, making a total of more than 2.00 inches of rain over the Monongahela, and well over an inch over the lower Allegheny Basin. There was not much snow on the ground over the lowlands, but on the mountains of West Virginia and western Pennsylvania the ground was covered to a depth of from 6 to 10 inches. The temperature was 40 degrees or above most of the time on the 2d and 3d, over West Virginia and the southern half of western Pennsylvania, which resulted in melting a considerable portion of the snow on the ground, thereby augmenting the run-off.

All the branches of the Monongahela River and their tributaries in West Virginia, rose rather rapidly to bankful and in most cases to considerably above flood stage. At Philippi, W. Va., on the lower Tygart River, the crest stage was 24.3 feet, or 4.3 feet above the flood stage, and the Middle Fork of the Tygart River was 7.0 feet above flood stage at Midvale. All the Tygart water, however, was impounded in Tygart Dam and was not permitted to reach the Monongahela River until the Monongahela had fallen to a few feet below the tops of the lock walls.

The Monongahela River rose to 37.4 feet, or 7.4 feet above flood stage, at lock No. 7, and was in flood from there to its mouth, due to the output of the West Fork and Cheat Rivers, both of which were considerably above flood stage. The Youghiogheny River also contributed considerably to the lower Monongahela, but it was not in flood except in the vicinity of Connellsville, where it was only slightly above flood stage.

The lower Allegheny River rose about 4.0 feet, but was not a large contributing factor in raising the upper Ohio River to 25.4 feet at Pittsburgh, 0.4 foot above flood stage, at 12:30 p. m., of February 4.

A rapid drop in temperature to 20° or below set in during the night of the 3d. This rapid-freezing condition quickly checked the run-off over the basins, and, as a result, the upper Ohio River did not reach the indicated stages.

While there was considerable overflow of the streams in the upper Monongahela Basin, the overflowed land was mostly farm or pasture lands, and little damage resulted, except between locks No. 7 and 4. In the lower Monongahela and the upper Ohio Rivers the water did not reach sufficiently high stages to damage property. The estimated money value of property damaged is $20,000, most of which occured in the vicinity of Brownsville, Pa., where a part of the town was submerged.

OHIO RIVER AND SOUTHERN TRIBUTARIES FROM BELOW DAM NO. 13 TO AND INCLUDING POINT PLEASANT, W. VA.

By S. S. SCHWORM

The Ohio River was rising in the Parkersburg district at the beginning of February 1939, cresting at dam No. 14, Ohio River, on the 1st (29.5 feet) and at Parkersburg on the morning of the 2d (28.1 feet). Below Parkersburg a slow rise was still in progress on the 2d and widespread heavy rains had begun early that morning, continuing well into the night of the 3d. Flood warnings were issued for the Little Kanawha Valley and for Point Pleasant, W. Va., and Pomeroy, Ohio, on the morning of the 3d. The average rainfall for the entire storm for the State was 2.20 inches; for the Little Kanawha Valley, 2.62 inches; for the southern division of the State (which includes the entire Great Kanawha and tributary basins), 2.55 inches; and for the immediate Great Kanawha Valley (Charleston to Point Pleasant), 3.28 inches. The heavy rains in the Little Kanawha and the Great Kanawha Valley produced the only flood stages in this district: at Little Kanawha, points above Parkersburg, and at Point Pleasant and Pomeroy. The Little Kanawha at Glenville was in flood on the 3d and 4th (crest 29.7 at 5 a. m., 4th) and at Creston on the 3d to 5th (crest 25.7 at 4 a. m., 4th), while the Great Kanawha rose to flood stage at Point Pleasant on the afternoon of the 3d and backed up the Ohio River as far upstream as Pomeroy, Ohio, where the water was about 2.5 feet above the local flood stage. At Point Pleasant the crest stage of 49.1 feet was reached at 1 p. m., on the 5th. In the meantime, a crest from the upper Ohio was moving rapidly downstream, but diminishing as it progressed, so that crest stages above Pomeroy ranged from 2.4 to 8 feet below flood stages, with the nearest approach to flood stage occurring at Parkersburg and Ravenswood (dam No. 22) and the remotest at dam No. 20, Ohio River. Due to the prevailing high water in the lower portion of the district, the Ohio crest practically disappeared at some point below dam No. 22. Only moderate rains fell over the Muskingum Basin during this storm, resulting in a rise of less than 2 feet at Zanesville. In fact, this river was falling when the Ohio was nearing flood stage at the confluence.

At West Glenville the water entered several business houses and flooded probably 50 basements, with an estimated damage of $2,000. At Creston the damage was minor, probably a few hundred dollars.

At Point Pleasant about 65 families were evacuated from their riverside dwellings and many stores had water in them, but the merchants had been forewarned and had moved their stocks to second floors. No damage estimates have been received, but the amount is probably less than $10,000. At Pomeroy only minor damage was reported, probably a few hundred dollars.

OHIO RIVER AND SOUTHERN TRIBUTARIES FROM AND INCLUDING THE MOUTH OF THE KANAWHA TO AND INCLUDING THE MOUTH OF THE KENTUCKY; THE NORTHERN TRIBUTARIES OF THE OHIO FROM DAM NO. 31 TO A POINT OPPOSITE THE MOUTH OF THE KENTUCKY

By W. C. DEVEREAUX

Due to heavy rains which fell over the watershed on February 2 and 3, averaging more than 3 inches in eastern Kentucky and western West Virginia, and slightly over 4 inches in southeastern Kentucky, the southern tributaries in this region rose rather rapidly during February 3, culminating in flood conditions in most of these streams between the 3d and 8th. Record-breaking stages occurred at Wayne, W. Va.; on Twelve Pole Creek; at Paintsville, Ky., on the Levisa Fork of the Big Sandy; at Jackson, Ky., on the North Fork of the Kentucky; and in the upper Kentucky as far down as lock No. 12.

At the time when the heavy rains set in the Ohio River was moderately high and rising throughout practically its entire length. In the Cincinnati district it rose at a moderate rate during February 2 and more rapidly during the 3d, reaching flood stages on the 4th from Gallipolis Dam to Portsmouth, and in the lower portion of the district on the 5th and 6th. Crest stages were reached between February 5th and 8th and these were from 3.6 feet to 9.6 feet above flood stage. Ample warnings were issued in advance of the flood.

The damage along the Ohio River was comparatively small. On the tributaries the greatest damage occurred at Jackson, Ky., and some of the smaller towns and villages on the North Fork of the Kentucky River.

OHIO RIVER AND TRIBUTARIES FROM BELOW MOUTH OF KENTUCKY TO AND INCLUDING HAWESVILLE, KY.

By J. L. KENDALL

The flood that culminated in this district on February 9–10 had its inception in the heavy rains that fell over the Ohio River Basin on January 29–30. This period of rain was followed by another from February 2 to 4 that was more extended and produced much heavier precipitation in the upper valley. The precipitation at this time on the north side of the upper Ohio Basin was moderate and ended with considerable snow that largely remained on the ground. On the south side of the basin, especially over the drainage of the Cumberland, Tennessee, Kentucky, Licking, and Big Sandy Rivers, the rains were heavy to excessive, ranging from 2.0 to 4.0 inches on February 2–3.

The rain of this second period was not especially heavy in the Louisville district, therefore the flooding in the middle section of the river was not strongly supported by local run-off. It was built up, however, by the large discharge of the Kentucky River from February 4 to 9, due to the excessive rains over its upper basin. Moderate temperatures and light rain on the 5th and 6th caused the snow covering to melt and pass slowly into the river, without much effect in augmenting the rise.

Heavy rains on the 10th, while the river was cresting in this district and after it had commenced to fall moderately in the upper section, started another slow rise above Cincinnati, but did not entirely overcome the slow decline that was beginning in the Louisville section. Heavy rains on the 15th, mainly over the basins of the southern tributaries, stopped the fall in this district and caused a slight rise.

The Ohio River passed flood stage from Louisville to dam 45 on February 5, and at Madison on the 6th. It crested as follows: Madison, 50.2 feet, February 8; Louisville, 35.1 feet, upper gage, 62.0 feet lower gage; dam No. 43, 63.0 feet, 9th; dam No. 44, 62.5 feet; dam No. 45, 54.1 feet, 10th.

During the decline the river returned to flood stage at Madison on the 12th, and at Louisville and dam No. 43, on the 13th. At dams Nos. 44 and 45 it remained above flood stage until after the second crest had passed downstream through that part of the district on the 17th.